

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO A FOLDER FOR FOLDING A SHEET

(71) We, GENERAL BINDING CORPORATION, of 1101 Skokie Boulevard, Northbrook, Illinois 60062, United States of America, a Corporation organised and existing under the Laws of the State of Delaware, U.S.A., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a folder for folding a sheet longitudinally while the sheet travels along a straight path.

According to the invention, there is provided a folder for folding a sheet longitudinally while the sheet travels along a straight path, the folder comprising means for conveying a sheet along the path so that a first part of the sheet passes under holder means having a straight edge extending longitudinally in the direction of travel of the sheet, and crossover guide means extending diagonally relative to the holder means across the direction of travel from a point below and to one side of the straight edge up and diagonally across the holder means and down substantially to the level of the holder means on the other side of the straight edge, the guide means being arranged to lift a second part of the sheet and to fold it down along a longitudinal line against the straight edge.

One of the most common types of folders for paper has rollers which cooperate with ramps to buckle the paper along a fold line with the buckled portion then passing between rollers to complete the fold. Paper is often folded into a signature, particularly in printing a book, pamphlet or the like. This requires that folds be made in different directions, that is, both longitudinally and transversely of a sheet, so that more than one folder is required. Sometimes three folders are used, the first folder serving to

make a fold along a transverse fold line across the sheet, the second folder then making a second fold along a longitudinal fold line, and the third folder making still another fold, again along a transverse fold line. With this arrangement, however, it is necessary to change the direction of travel of the sheet as it passes through the three folders in successive order. The sheet travels through the first folder in a first direction, then makes a right angle turn and passes through the second folder to produce the longitudinal fold, and then changes direction again to pass through the third folder in the first direction. It is desirable to feed sheets rapidly through the series of folders to maximize production in a folding operation. However, where the sheet must change directions in the manner just described, the sheet which is turning must get out of the way of the next successive sheet before that latter sheet can be fed into the second folder. Consequently, in passing through the series of folders, the sheets are spaced apart from each other enough to allow one sheet to change direction and get out of the way of the next sheet before it reaches the point where the direction of travel changes. As previously mentioned, this slows down the folding operation.

The folder of the present invention, is preferably used as the second stage in a three stage folding system, the first and third stages being conventional and both serving to fold the sheet along a transverse fold line in the manner described previously. The sheet travels in the same general direction through the entire folding system and since no change of direction of the sheet is involved, the space between successive sheets can be minimised to speed up production.

The invention will be readily understood from the following illustrative description and accompanying drawings, in which:

Figure 1 is an elevational view of a folding

apparatus including as the second stage or section thereof a folder embodying the invention;

Figure 2 is a plan view of the second folder of the folding apparatus of Figure 1;

Figure 3 shows a sheet after it has been folded once by the first folder of the apparatus and then perforated along a line which is to be the second or longitudinal fold line;

Figure 4 is a sectional view taken along line 4—4 of Figure 2;

Figure 5 is a sectional view taken along line 5—5 of Figure 2;

Figure 6 is a sectional view taken along line 6—6 of Figure 2;

Figure 7 is a sectional view taken along line 7—7 of Figure 2;

Figure 8 is a plan view of the second folder or folding stage illustrating the action of a crossover guide in folding a sheet along a longitudinal fold line;

Figure 9 shows the sheet after the second fold has been made;

Figure 10 is a plan view of a modification to the folder for making a longitudinal fold;

Figure 11 is a plan view of another modification of the folder;

Figure 12 illustrates the action of flowing air in supplementing the crossover guide included in the folder of Figure 11; and

Figure 13 further illustrates the action of the cross-over guide in the embodiment of Figure 11.

Referring first to Figure 1, a three stage folding apparatus is shown including a first folder 20, a second folder 22 and a third folder 24. A sheet of paper or other like material passes through the three folding stages in the direction of the unnumbered arrow. There is no change in direction of the sheet as it travels. The first folder 20 folds the sheet once along a transverse fold line, and the resulting folded sheet 26 is shown in Figure 3. This particular sheet has been perforated at 28 along a line which is to become a longitudinal fold line as will be described further. After the sheet has been folded once, it passes through the second folder 22 which folds the sheet 26 along the perforated line 28 without changing the direction of travel of the sheet. The resulting twice-folded sheet 26 is shown in Figure 9. Then the sheet goes to the third folder 24 which folds it along another transverse fold line to produce a signature of the type commonly used in the printing trades.

The first folder 20 and the third folder 24 are completely conventional, and these folders will not be described herein since they are readily commercially available. They may be of the type which include rollers cooperating with ramps and wherein the sheet passes up a ramp to a stop, after which the sheet buckles and the buckled

portion passes between rollers to produce the fold.

Referring to Figures 1 to 9, the second folder 22 is shown in more detail. It has conveyor belts 30, 32 and 34 driven by a drive shaft 36 and an idler shaft 38. A motor and belt drive system are indicated diagrammatically at 40 and serve to drive the shaft 36 and thus drive the belts 30, 32 and 34 in the direction of the arrows shown on the belts. The paper is guided by an adjustable side rail 29. The drive system 40 also drives another shaft 42 on which a toothed perforating disk 44 is mounted along with other guiding disks 46. There is a backing roll 45 under disk 44. The shaft 42 and disks 44 and 46 may be mounted either on the frame 48 of the second folder 22, or may be included in the first folder 20, if desired. Mounted on a crossbar 50 are holders 52, 54 and 56 under which one side of the paper sheet 26 is transported by the belts 30, 32 and 34. Holder 52 is attached to the crossbar 50 by a screw 53. The two holders 54 and 56 are in the form of bars suspended from posts 58 and 60 which are attached to the cross-bar 50 as by means of a set screw 52. The bars 54 and 56 have openings in which balls 64 and 66 are confined loosely such that the balls will ride on the paper 26 as it travels through the folder to hold down the underlying portion of the paper.

The other holder 52 is in the form of a resilient band, one end of which is attached as with a screw to the crossbar 50. The band 52 simply curves down toward the belt 30 and rides on top of the sheet 26 as it travels through the folder. The holder 52 serves as a straight edge located at a central portion of the folder and it may be noted that the perforated disk 44 is lined up with the edge of the holder 52. Thus, when the longitudinal fold is made, the paper folds across the holder 52 along the line of weakening 28. Folding is accomplished primarily by a crossguide 70 which extends diagonally relative to the holders 52, 54 and 56 from a point at 72 up and then down beyond the holders. In this embodiment, the crossguide 70 extends almost fully across the width of the folder and is affixed to the opposite side of the frame 48 by a set screw 74. It may be seen that the crossguide 70 in this embodiment is a band which twists one-half turn. The sheet 26 rides over the leading edge 72 of the band 70 and is lifted by the band and pushed over against the edge of the holder 52 and then down on the far side of the sheet to complete the fold.

The action of the crossguide 70 is shown particularly in Figures 7 and 8. As shown there, the free side of the sheet 26 initially rides up the upwardly slanting portion of the crossguide 70, and the sheet in this position

is designated 26a. As the sheet progresses, it reaches the position where it is designated 26b. The sheet at 26b has been partially folded along the line of weakening 28 against the holder 52. When the sheet progresses to the position where it is designated 26c, the far end of the crossguide 70 is forcing the free portion of the sheet down on the retained portion thereof to complete the fold. The sheet is also travelling out from underneath the holders 52, 54 and 56. This final downward folding of the sheet is aided by an air jet supplied from a nozzle 80, the jet being directed at the top side of the partially folded sheet. When the sheet reaches the position where it is designated 26d, it has been completely folded and is emerging from the second folder 22 and passing into the third folder 24.

The crossguide 70 is capable of folding the sheet without the assistance of the air jet 80 but the cooperative action of the crossguide 70 and the jet 80 is beneficial.

Figure 10 shows a modification of the embodiment of Figures 1—9, the only difference being that the crossguide 90 is in the form of a rod or wire rather than a band. Since this is the only difference in the two embodiments, the same reference numerals have been used for like parts, and the operation of the apparatus is exactly the same as described previously.

Figures 11 to 13 show another modification wherein the cross-guide 100 is a tube from which air is directed on the paper to assist in the folding action. The tube has openings such as the openings 102 and 104 shown in Figures 12 and 13. The openings 102 towards the leading end of the crossguide 100 direct air sideways and somewhat upwards to lift the free side of the paper sheet 26 in the manner shown for example at 26b. The openings 104 towards the trailing edge of the crossguide 100 direct air downwardly to assist in folding the sheet down as shown at 26c. Of course, the air jet in this embodiment is incorporated into the crossguide 100 so that no separate air jet is needed. In all other respects, the apparatus of Figure 11 is identical to that of Figures 1 to 9 so the same reference numerals have been used for like parts.

WHAT WE CLAIM IS:—

1. A folder for folding a sheet longitudinally while the sheet travels along a straight path, the folder comprising means for conveying a sheet along the path so that a first part of the sheet passes under holder means having a straight edge extending longitudinally in the direction of travel of the sheet, and crossover guide means extending diagonally relative to the holder

means across the direction of travel from a point below and to one side of the straight edge up and diagonally across the holder means and down substantially to the level of the holder means on the other side of the straight edge, the guide means being arranged to lift a second part of the sheet and to fold it down along a longitudinal line against the straight edge.

2. A folder as claimed in claim 1 in which the crossover guide means comprises a fixed crossover guide extending from the one to the other side of the holder means.

3. A folder as claimed in claim 2 in which the crossover guide comprises a twisted band.

4. A folder as claimed in claim 2 in which the crossover guide comprises a rod or wire.

5. A folder as claimed in claim 2 in which the crossover guide comprises a tube.

6. A folder as claimed in any preceding claim having means for directing air on the second part of the sheet lifted by the crossover guide means to assist in producing the fold.

7. A folder as claimed in claim 5 in which the tube has at least one opening through which air can be directed on the second part of the sheet lifted by the tube to assist in producing the fold.

8. A folder as claimed in claim 7 in which the tube has one or more first openings arranged to lift the second part portion of the sheet and one or more second openings arranged subsequently to fold down the lifted second part.

9. A folder as claimed in any preceding claim having means to weaken the sheet along the longitudinal fold line before folding.

10. A folder as claimed in claim 9 in which the weakening means comprises a perforating disc.

11. Folding apparatus for folding a sheet successively in each of three folders to produce a signature without change in direction of the travelling sheet, the apparatus comprising a first folder arranged to convey the sheet therethrough in a certain direction and to fold the sheet along a fold line transverse to the direction, a second folder as claimed in any preceding claim arranged to receive the sheet from the first folder without a change in the direction of travel of the sheet, and a third folder arranged to receive the sheet from the second folder without a change in direction of travel of the sheet and to fold the sheet again along a fold line transverse to the travel direction, thereby producing the signature.

12. Folding apparatus substantially as herein described with reference to Figures 1 to 9, Figure 10, or Figures 11 to 13 of the accompanying drawings.

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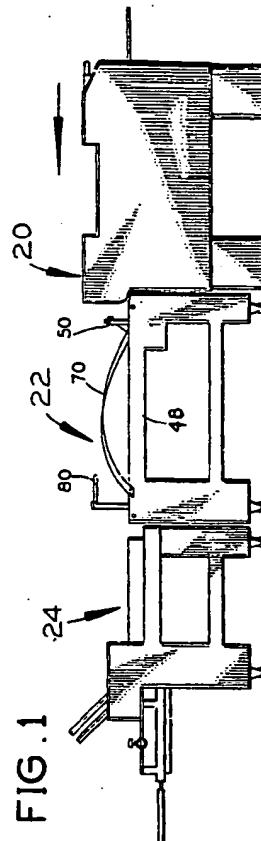
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COMPLETE SPECIFICATION

7 SHEETS

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Sheet 1*



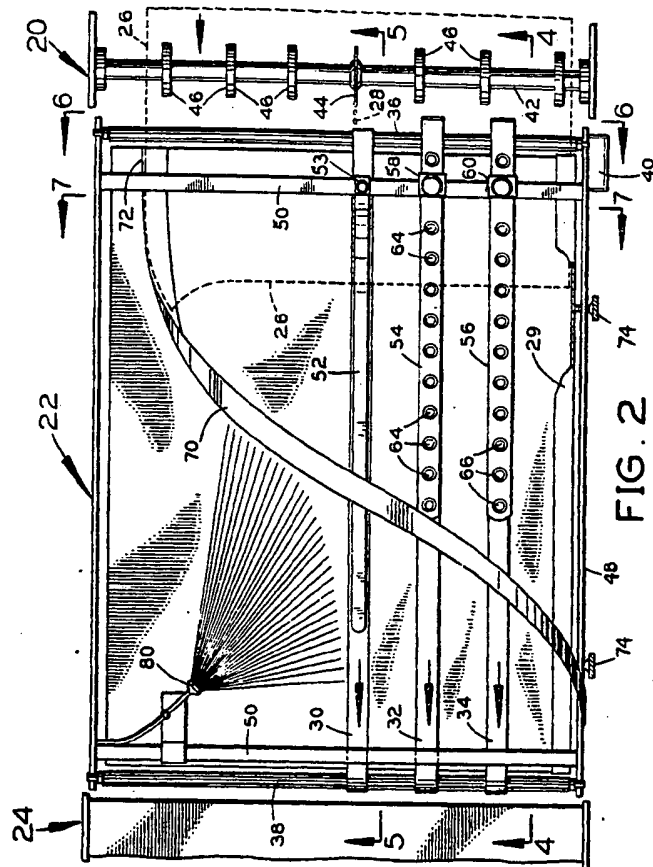


FIG. 2

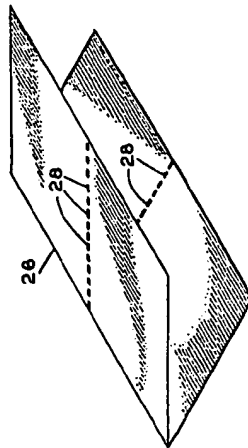


FIG. 3

FIG. 6

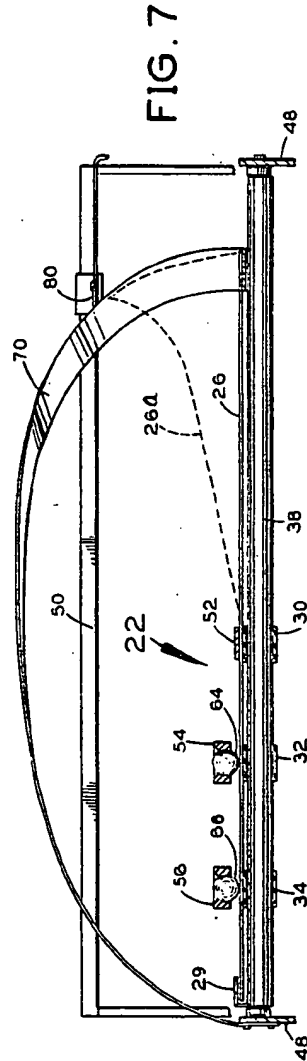
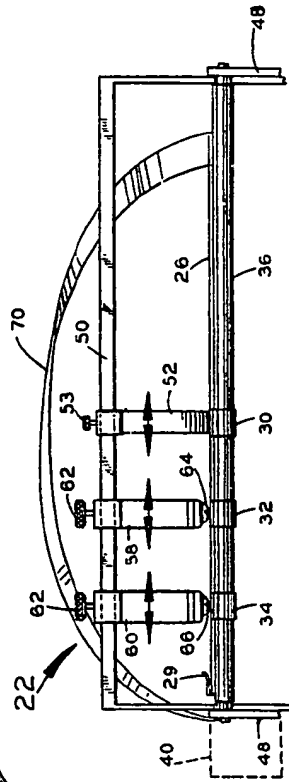


FIG. 7

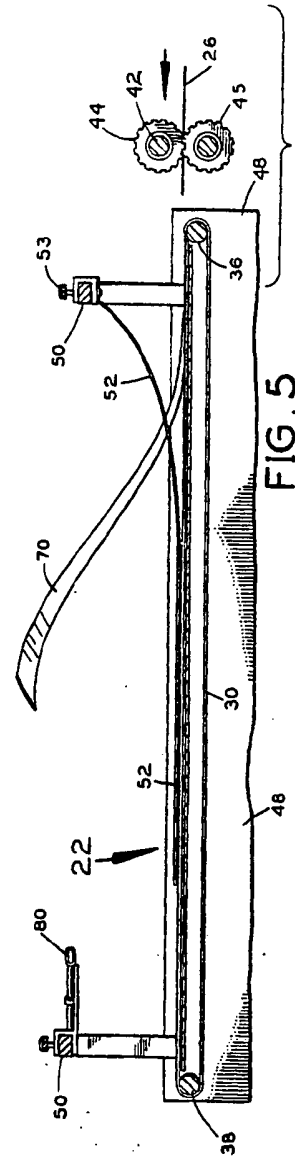
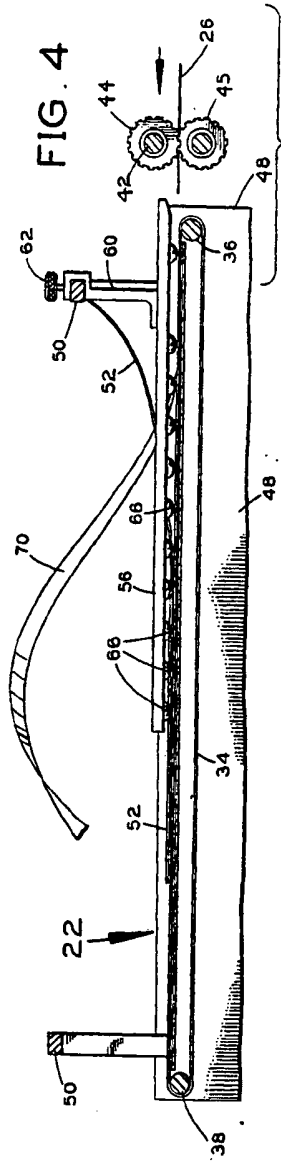
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7 SHEETS

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Sheet 4



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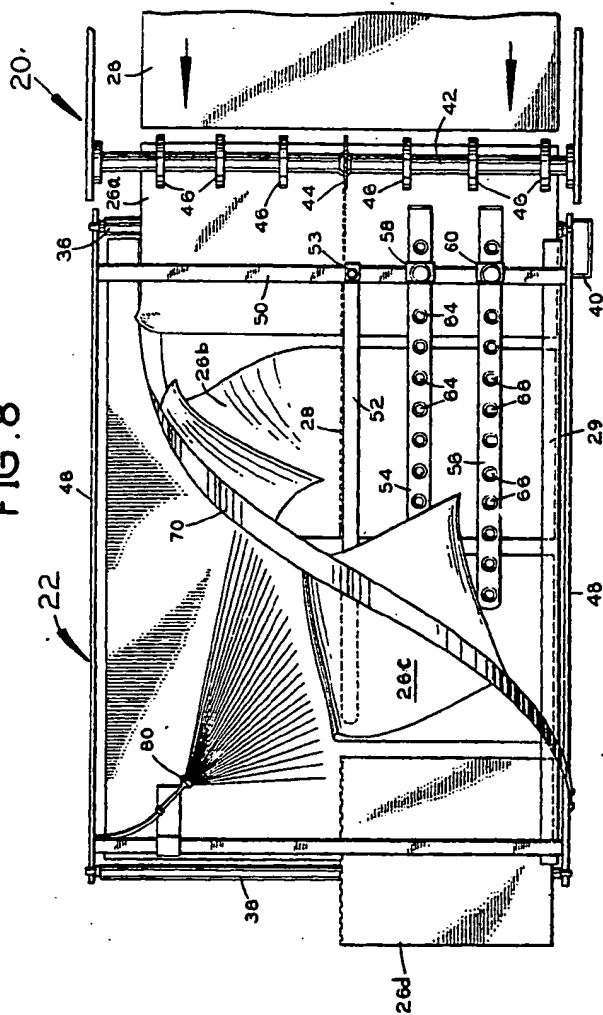
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7 SHEETS

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Sheet 5

FIG. 8



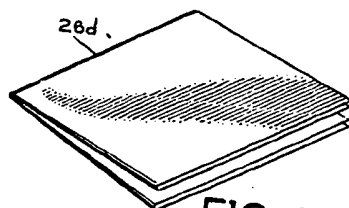


FIG. 9

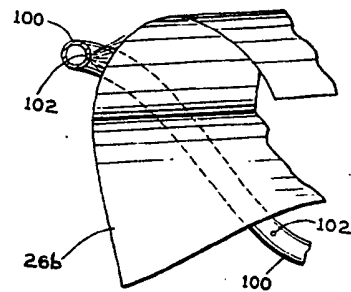


FIG. 12

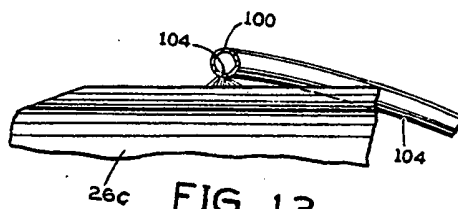


FIG. 13

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Sheet 7

FIG. 10

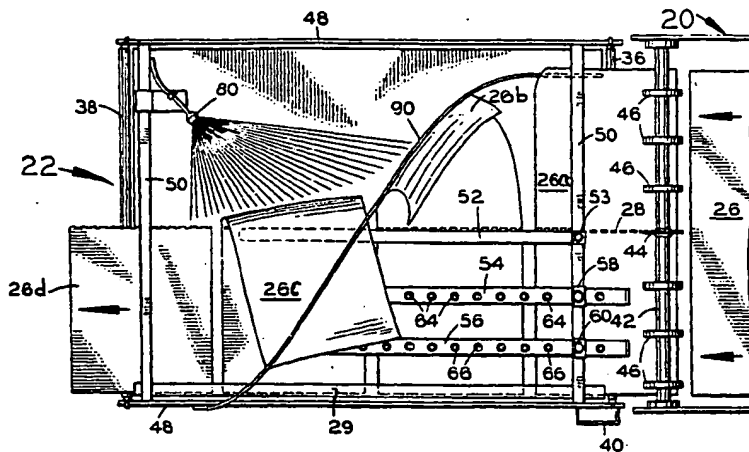
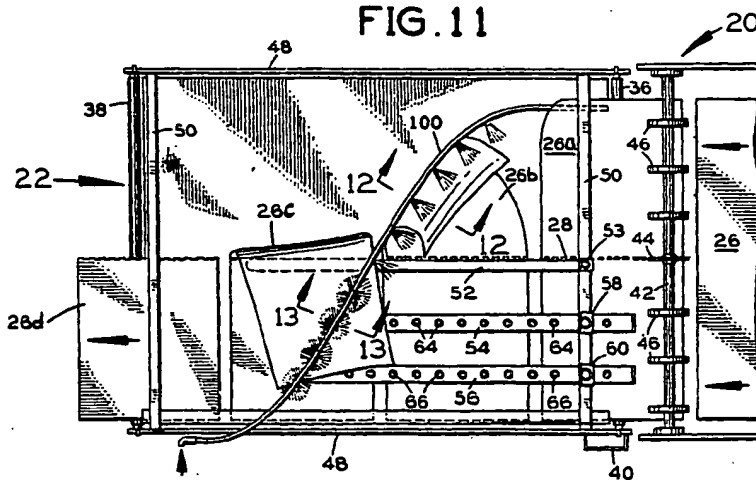


FIG. 11



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